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GENERAL ARTICLES

THE TECHNIQUE AND STANDARDISATION OF RADIOGRAPHS OF TUBERCULOSIS OF THE CHEST*

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So much has been written during the past thirty years on the technique and standardisation of radiographs of the chest that I feel I cannot add any substantial contribution. Particularly is this so since the publication of the Special Report, No. 251, of the Medical Research Council; for this contains the considered and combined opinions of four workers—a radiologist, two clinicians and a technician—who set out " to establish standard methods and procedures in order to assist those responsible for the routine of the national service." The report is a very comprehensive one, dealing with choice and arrangement of premises, electric supply, water supply, the alignment of apparatus and adjustment of distances for taking direct radiographs and miniature photographs of the screen image, positioning of patients, exposure technique, darkroom procedures, protection of staff, and many miscellaneous matters about radiography, apart from the administration and technique advised for mass radiography of civilians.

The best radiograph of the chest obtainable should be the aim of all technique and standardisation. It should cover the whole of the lung fields and give sharp definition of the cancellous structure of the anterior and posterior segments of the ribs and all structures within them which are capable of being visualised by their contrast density when the optimum penetration of radiation is employed. To obtain such radiographs we need:

(1) The confidence and co-operation of the patient, to give as complete immobility as possible during exposure.
(2) The closest possible contact of the patient with the film—the relative position according to the projection required.

* Read at a meeting of the Tuberculosis Association, November, 1946, in opening a discussion on this subject.

(3) The finest grain of the film and intensifying screens, the former being held throughout with uniform compression between the screens.
(4) A fine focus tube placed at such a distance that emitted radiations, passing through the patient, are relatively parallel.
(5) Activation of the tube for the shortest possible time by a stabilised transformer unit which will always give the desired milliamperage and kilovoltage required for the necessary penetration and contrast.
(6) Careful darkroom technique in the processing of the films.
(7) Inspection of the radiographs against a uniformly lighted surface, permitting visualisation of the higher degrees of contrast transparency of the films.

With attention to these features, a good general standard of radiography will be attained; but many influencing factors are so variable that even when we apply conditions to the same patient which we think are identical, we obtain radiographs which are distinctive and readily distinguished from others. We must always consider this when assessing the radiographs.

The confidence and co-operation of the patient are secured by explaining to him what is going to be done and what is essential for success, and that he will not feel either discomfort or pain. Even the contact-breaker should not make any disturbing noise. He should be coached in the necessity to take a deep breath, hold it, and then keep quite still when the warning of imminent exposure is given. A trial drill without exposure often avoids a wasted film, particularly with young or nervous patients.

The patient is positioned with the anterior surface of the body pressed into the closest possible contact with the casette, with the apices exposed. The lung fields should be freed from the shadows of the scapulæ by depressing the shoulders, placing the back of the patient's hands on his buttocks with his elbows pushed forwards. To cover the apices adequately the head is elevated and the chin rested against the top of the casette. It is not always possible to secure this standard position. The patient who is too ill to be moved from bed cannot be positioned in this way, and we have to do the best his condition will permit. Actually the densities of the scapulæ do not always reduce the diagnostic value of the radiograph—in fact, I have seen soft shadows recognised through the superimposed scapular shadows, which could not be seen on subsequent radiographs, taken with technique designed to clear the scapulæ from the lung fields.

This postero-anterior radiograph is all that is necessary at the first examination (Fig. 1, Plate I, and compare with Figs. 3 and 4, Plate II). When it has been processed and inspected by a competent observer, the necessity for further standard or special projections can then be determined (Fig. 2, Plate I). For the most part these will be needed to localise and determine the characters of shadows seen in the first film. To take lateral or oblique radiographs in either direction, antero-posterior radiographs in the normal or lordotic position, or either, with the patient erect or lying down, as a routine at the first radiographic examination, involves very considerable, and I think unnecessary, expense, particularly if there is no clinical evidence to support their demand, even though occasionally they give evidence which is not recognised

on the standard postero-anterior radiograph. Using the inferior miniature photograph of the screen image, my belief is that early lesions may be overlooked, though it has been said that the number so missed is small and negligible. I am convinced that the errors are greater than after careful examination of direct postero-anterior radiographs. If an abnormal shadow has been seen on the postero-anterior radiograph, or the clinical examination throws suspicion on an area, it may be possible during screening to observe inspiration and expiration, and then to rotate the patient into the best position for obtaining the desired evidence. In this way the number of radiographs taken can often be reduced. It is interesting to note that in the Report of the Medical Research Council, to which I referred, the authors state: " An A.P. view gives a different view of the apices, and since many tuberculous lesions are situated posteriorly, the A.P. view may show up such lesions with better definition. *In a number of cases* the A.P. view showed a frank cavity which was invisible in the P.A. view. As an aid to the estimation of the extent and age of a tuberculous lesion, the combination of the P.A. and A.P. views is most valuable and the taking of these is now our routine practice with large films." Yet, strange as it seems to me, they advise the inferior miniature photograph of the postero-anterior screen image of patients who have not had any clinical examination, as an adequate sieve for the detection and eradication of tuberculosis. I am not prepared to support the claim or advice given in the last sentence of the quotation: invaluable as this may be in some cases as a routine procedure, I regard it as a relatively useless expenditure of material and time. In support of postero-anterior radiographs is the fact that in this projection posterior lesions are somewhat magnified.

It must not be forgotten that tuberculosis of the dorsal spine, the paravertebral tissues and the ribs comes within the scope of this paper, and at times calls for special radiographs for differentiation (Figs. 8 and 9, Plate IV), though more commonly such lesions are not associated with pulmonary tuberculosis. Lesions affecting the paravertebral tissues are rendered visible when they push laterally the medial borders of the lungs. It is the line of demarcation between the relatively radio-opaque paravertebral tissue and the transparent lung which we see—the same abscess or lesion beneath the diaphragm, or which did not push aside the lung, is not visualised by radiography. Some of the lesions have characteristic appearances, but others necessitate further radiographs taken with radiation of greater penetration to show bone structure, for the type of change in the bone may give a very important clue to the nature of the lesion.

Special radiographs need to be taken in certain cases of pulmonary tuberculosis associated with a localised pneumothorax or fluid collections. For the latter the position of the patient is the most important thing, as the position of fluid is determined chiefly by gravity, though influenced also by the condition of the pleura, the lung and the nature of the fluid; and this permits demonstration of the extent of a cavity. For this purpose the patient should lie on a radio-transparent support in the desired position, with the film tight against the patient, and vertical to the couch top, and the rays projected parallel with the latter from a tube placed at the side of the recumbent patient. Elevation or depression of the foot of the couch may give additional help.

The factors employed must be recorded on the film for guidance in interpretation and for further comparative radiographs.

The use of special techniques must be considered for certain cases. A supplementary lateral radiograph is usually the best for localising lesions. Sometimes stereoscopic radiographs may give valuable information, when taken with the necessary radiation to show the outlines of questionable structures—much more, I feel, than can be obtained by tomography, for in assessing the latter considerable licence is taken which is not always justified.

Radiographs taken in full inspiration and full expiration may give useful additional evidence, particularly when there has been surgical intervention. After thoracotomy, because of the lack of contrast density from collapse of the lung and the approximation of denser bony structures, the lung field in the area may be obscured on a radiograph taken with the radiation penetration to show the lung structure of the opposite side. Radiographs taken with greater penetration of the obscured area may reveal additional important evidence. But the necessity for such special films (Figs. 10 and 11, Plate V) should be determined by careful inspection of the postero-anterior radiograph in the light of evidence given by the clinician. Each case must be dealt with on its merits. Collections of special radiographs taken without intelligent direction are a source of great expense and may delude or confuse the clinician rather than help him.

The latest films and intensifying screens permit of very short exposures and are of fine grain. When the films are processed according to the manufacturer's instructions they leave little to be desired for chest radiography, providing that the screens are kept clean, and in intimate contact with the film throughout the exposure. If contact is not intimate in any area or areas, the detail within may be obliterated and the evidence lost. Only too often films are seen in which this has occurred. Because the defects are ill-defined from their nature, they tend to be overlooked. Considerable fine detail is lost, even with the best of screens. Films tend to lose their sensitivity with time, and the manufacturers periodically produce a faster film. These factors necessitate a revision of exposure times. This variation in film speed is of more importance than may be thought. It can be very confusing to those who do not appreciate it. Standardisation may be very materially affected.

The tube should have a fine focus and permit of such current that radiographs can be taken at a distance of 6 feet from the film, so that the rays passing through the patient are practically parallel and distortion reduced to the minimum. To do this requires a stabilised transformer unit of considerable output. Most of the larger units today will give 300 M.A. at a K.V.P. of from 50-90; with an exposure of 1/20th of a second, and a distance of 6 feet between the tube and the film, this gives the best radiographs of most patients.

The quality of the radiograph is determined by the relative milliamperage and kilovoltage. We are not all alike in our assessment of quality. Most experienced radiologists do not care for very contrasty radiographs: they prefer those that show a large gradation in the half-tones, for abnormal densities can be recognised in these more easily even when they are superimposed on the heart or the bony structures of the ribs or scapulæ.

The rotating anode tube is the ideal tube to use with such a unit and

PLATE I

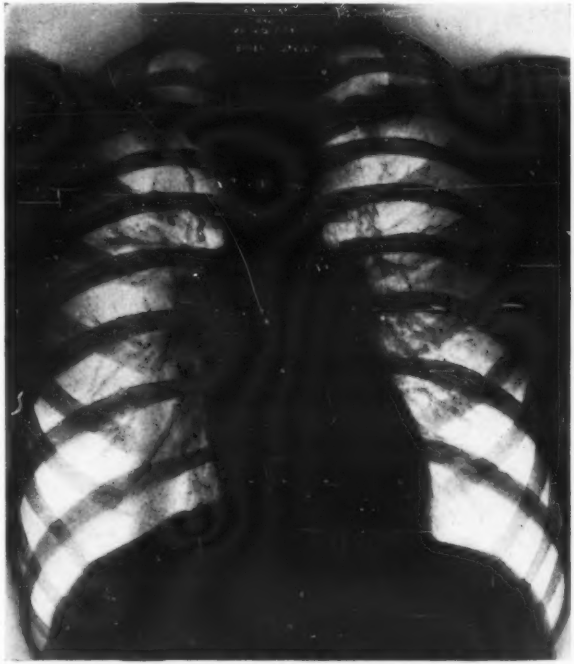

FIG. 1.—STANDARD EXPOSURE AND POSITION. P.A. 6 FT. EARLY TUBERCULOUS FOCUS IN 4TH RIGHT INTERSPACE NEAR AXILLARY BORDER.

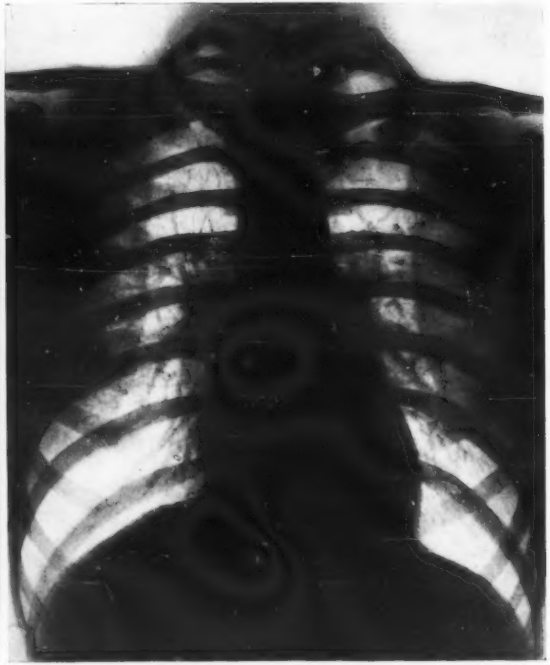

FIG. 2.—STANDARD EXPOSURE AND POSITION. A.P. 6 FT. THE EARLY FOCUS IS SHOWN WITH SLIGHTLY SHARPER DEFINITION, BUT SMALLER.

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PLATE II

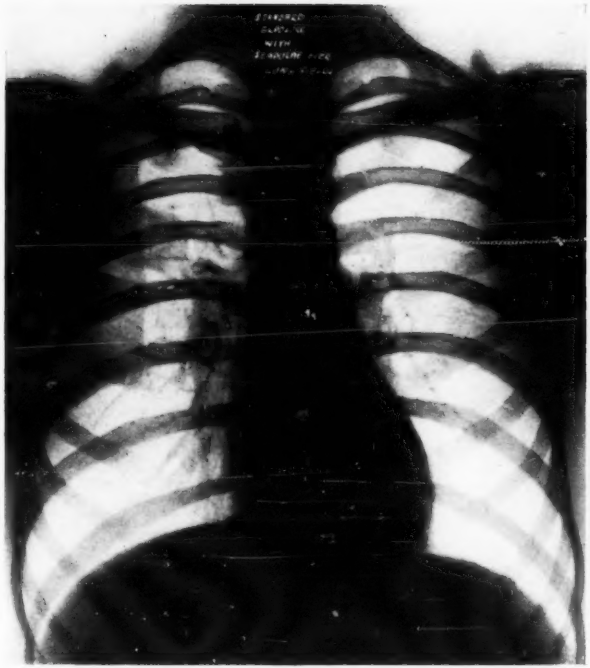

FIG. 3.—STANDARD EXPOSURE WITH SCAPULÆ OVER LUNG FIELDS. P.A. 6 FT. THE EARLY FOCUS CANNOT BE SEEN.

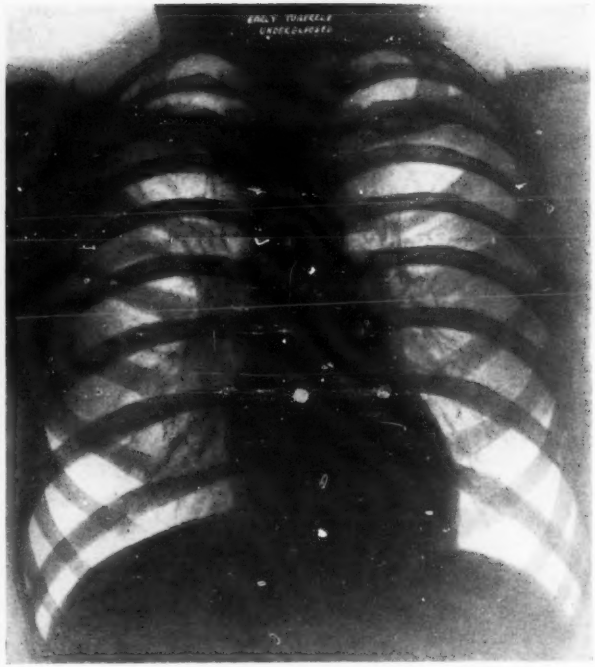

FIG. 4.—UNDER-EXPOSURE. 6 FT. LUNG STRIÆ APPEAR TO BE INCREASED, BUT FOCUS LOST IN THE OPACITY OF THE LATERAL ASPECT OF THE CHEST.

To face Plate III

PLATE III

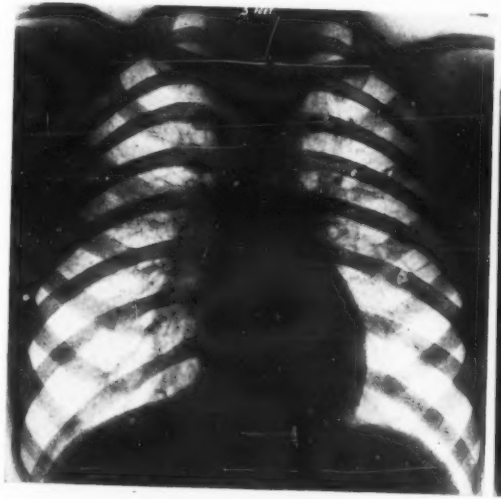

FIG. 5.—NORMAL PATIENT AT 3 FT. STANDARD EXPOSURE

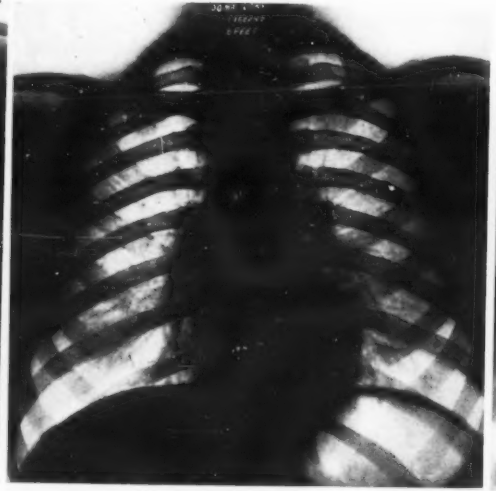

FIG. 6.—NORMAL PATIENT AT 6 FT. ONE SECOND EXPOSURE

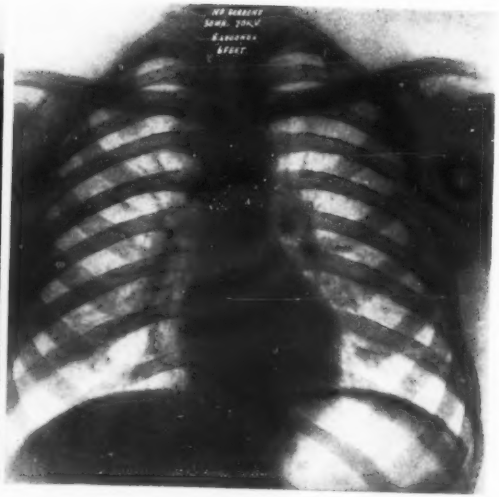

FIG. 7.—NORMAL PATIENT AT 6 FT. EIGHT SECONDS EXPOSURE. NO SCREENS.

[To face Plate II

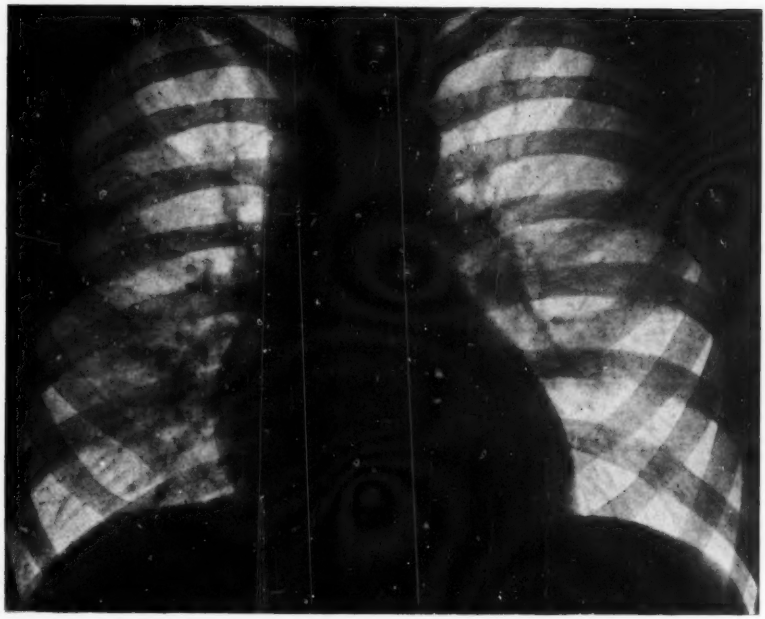

FIG. 8.—STANDARD EXPOSURE FOR LUNGS AT 6 FT. DETAIL OF PARAVERTEBRAL TISSUE LOST IN OPACITY OF HEART AND SPINAL STRUCTURES.

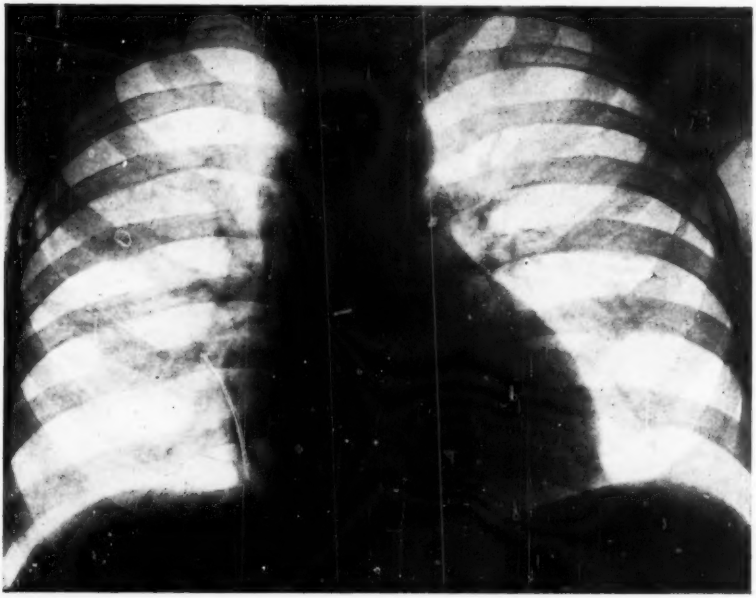

FIG. 9.—SAME PATIENT AS FIG. 8. WITH GREATER PENETRATION A PARAVERTEBRAL ABSCESS IS SHOWN THROUGH THE HEART SHADOW.

[*To face page* 5

technique. It permits of the shortest possible exposures—and short exposures prevent the obliteration of fine structures by movement. But the use of a rotating anode tube is expensive, as its price is high, and its life is relatively short, depending upon the number of exposures. Without it, calculation of expense can reasonably be made on the size and quantity of the films used; but with it, the chief expense is the tube, and calculations must be reckoned on the number of exposures. Nevertheless, where the tube is in constant heavy use this expense must be faced. A stationary fine-focus tube will produce radiographs of good diagnostic value for ordinary routine department work: they do not show the same crispness of definition, but for practical purposes they leave little to be desired at a minimum expense.

In my opinion, with our present state of knowledge, it is not possible to show, on a radiograph taken with a rotating anode tube, diagnostic features which are not present on a radiograph taken with a fine-focus tube. Even a modern portable unit of reliable manufacture, using an exposure of half a second, 15 M.A. of current and a distance of 4 feet between tube and film, will give a radiograph of good diagnostic value. As such units are used essentially for sick patients in bed, the pathological lesions are usually gross, and we are not so concerned with the fine soft shadows of early disease. Experience is essential for obtaining the best radiographs; but individual units today are provided with the manufacturer's instructions for operation and standardisation of results, and the results depend upon following these instructions intelligently. The question of distance is largely determined by length of exposure as the law of inverse squares operates. A distance of 6 feet between tube and film needs a big unit, for this distance is outside the range of the small unit if the exposure is to be kept at a fraction of a second. The shorter the distance, the greater the distortion, but at 4 feet this is not materially prejudicial in the diagnosis of pulmonary tuberculosis. It is interesting to see the comment which is made on this in the Medical Research Council's Report. "It is obvious that the closer the detail of the miniature radiograph approximates to that of a full-size film, the more accurate is the interpretation. Indeed, because of the short distance (36 inches) at which miniature radiographs are taken, *the apices tend to be shown more clearly in the miniature film.* But this short distance carries the handicap that the anterior borders of the ribs, the soft tissues of the chest wall, and the root shadows, tend to stand out with undue clarity at the expense of the smaller pulmonary vessels." I do not think there is any justification for the last sentence. Radiographs taken at 3 and 6 feet cannot be distinguished by these features (Figs. 5, 6 and 7, Plate III)—in fact, there is probably only one feature which enables you to identify which is which—namely, the definition of the cancellous structure of the ribs. In the latter respect the greater focus-film distance gives the better definition. For diagnosis of pulmonary conditions there is little or no advantage in the greater distance. If, because of the short distance, the apices tend to be shown more clearly, it is surprising that the greater distance of 5 feet is advised for the direct large radiographs from which the diagnosis is made. There is no question in my mind that even direct films taken with portable units are superior in diagnostic value to the miniature photograph of the screen image; the essential superiority of the latter is only in its speed and cheapness for large

numbers, and not in its quality or diagnostic value, though it is claimed that an average speed of interpretation of 400 per hour was reached.

Careful darkroom technique is essential whatever the units used. There is a tendency, even when rotating anode tubes are operated by expensive modern large units, to use primitive darkroom equipment. Instruments of the greatest precision with fool-proof instructions on their workings, to give the desired milliamperage at the desired kilovoltage for the desired fraction of a second, are used to activate films which are then processed with all the licence a novice can desire. This is not absent from the mass radiographic units, where much else has been done to produce uniformity of results. With anything else but the large unit the darkroom equipment is correspondingly poor. Whatever the unit used, even if only a portable called for once a day, the expense of a thermostatically controlled developer unit, operated at correct time and temperature, is justified and essential, if standardisation of results is to be secured. Initially some radiographs will be spoilt by wrong exposure, but once experience has found the correct factors the failures will be minimal and the general standard good. Good washing-water is essential, and preferably the films should, after thorough washing, be dried in one of the electrically heated drying-cabinets, to prevent damage from dust or persistent droplets of water. Intensifying screens are said to be washable. Any radiographer caught washing a screen should be severely reprimanded; for when screens are dealt with carefully, washing should not be necessary, even after years of use. Many screens are spoilt by careless handling, and the artefacts produced on the films have been responsible for serious errors in interpretation.

It must be realised that the condition of the developer has an important bearing on the processed radiograph. Freshly made developer appears to require a little time—24 hours—for maturation to give the best results. Stale developer, or that which has been deprived of some of its chemical constituents by over-use, results in a reduction in the standard quality according to the degree of staleness or over-use.

The radiograph should be judged and interpreted when it is completely dry by illuminating it in one of the excellent viewing-boxes now available. Judgment on wet films is not advisable, not so much because of hurry to obtain the evidence which the radiograph shows, as the desire to get on with other work. The demands of the latter have a very serious effect on the accuracy of our observations and judgments, and lesions are missed which at a later inspection appear obvious. It is stated in the M.R.C. report: " Discussions on the probable diagnosis arise when other medical men are present. Such discussions are often futile and a waste of time; and we agree with Trail that interpretation of the *miniature* radiograph should be left to one individual." It is certainly much easier, particularly for the novice, to run through 400 films in an hour if there is no one to question the decisions. Personally, I would rather say that unless the experienced observer is accompanied by another skilled in diagnosis and/or interpretation, it is probably best in the first instance to assess the film alone.

In conclusion, it should be said that radiographs taken in the standard positions with modern X-ray units and processed in good developer in a

thermostatically controlled tank will reach a high standard. The more nearly radiographs reach the high standard described the less will the technical factors confuse the interpreter. So many variable factors are involved that uniformity is not attained. Already certain contrivances are being put on trial which diminish the variability of some of the factors—*i.e.*, exposures controlled by a photo-electric cell; automatic processing and drying. There will probably always be considerable differences in the X-ray units operating in different institutions, and these units will be used by persons equally varied in their opinions as to what is the best radiograph. The range in quality is and will be very wide—it can be wide, and yet the radiographs may or may not be of great diagnostic value. This largely depends on the experience, knowledge and ability of the person who is called upon to direct the radiography and to assess their value. Such a person ought to direct, or be capable of directing, the radiographer in all that he does and of recognising immediately all the defects of faulty technique and processing. Unrecognised by the chief they will recur and the general standard will be poor or deteriorate, for their importance to the patient will not be appreciated. Today too much is left to the technician because too little is known of these essential features by the medical officer. Even the best radiograph can be useless, indeed harmful, when a wrongful interpretation is allowed to dominate the patient's treatment. Wholehearted co-operation between clinician and radiologist is the best security against errors.

BRONCHO-STENOSIS IN PULMONARY TUBERCULOSIS

A PROBLEM IN TREATMENT

By MAURICE DAVIDSON

From the Brompton Hospital

The general management of individual cases of pulmonary tuberculosis continues to be a source of anxiety to the conscientious physician. In spite of the increasing measure of control over the activities of the disease with which modern technique has furnished us, we are still confronted at intervals by unexpected difficulties in the planning of our treatment, the solution of which does not follow automatically on the enunciation of the various medical and surgical principles that the last few years have taught us. The following case presents some rather unusual features, is an example of these difficulties, and provides interesting matter for discussion and argument.

The patient was a girl, aged 23, whom I first saw in July 1943, and admitted to the Brompton Hospital for investigation. She had already been examined there as an out-patient when she was 18 because of a cough and slight tachycardia. No evidence of tuberculosis was found at that time, the X-ray appearances being normal and the sputum test for tubercle bacilli negative. The X-ray examination was repeated about 5 months later, and still showed no evidence of tuberculous infiltration (March 3, 1939).

In 1942 she had an attack of bronchitis which left her with a persistent cough and general debility, and her doctor sent her to St. Bartholomew's, where X-ray examination showed a lesion of the left lung, and tubercle bacilli were found in the sputum. She was transferred to a municipal hospital in her own district, where induction of left A.P. was attempted twice without success. She was then sent to a sanatorium (October 1942,) where she remained for some months until discharged home (March 1943), where she continued on complete bed rest until July 1943, when I was asked to see her. She was eventually taken into Brompton on October 25th.

On admission her general condition was good, her weight being 10 st. 1 lb. (in August 1942 it was 9 st. 7 lb.). Physical examination of the chest showed slight dullness in the upper zone on the left side with a few adventitious sounds, chiefly rhonchi, at the base. There was moderate clubbing of the fingers. The sputum contained tubercle bacilli. There was no pyrexia.

The radiograph of the chest (Fig. 1, Plate VI) showed infiltration in the middle and lower zones on the left side, the right lung being normal. The heart was seen to be displaced to the left.

In view of her failure to make satisfactory progress in spite of prolonged rest, the pulmonary lesions being fairly extensive and the sputum persistently positive, I determined to make another attempt to induce a left A.P. This was done on October 28, and the treatment was continued as usual. Complete collapse was prevented by apical adhesions, which were therefore divided by my colleague Mr. R. C. Brock on January 12, 1944, with satisfactory results. A small fluid effusion occurred, but this gave rise to no appreciable trouble and she was discharged home on February 29, 1944, the refills being continued locally under the supervision of the local authorities.

It should be observed at this point that while she was in Brompton she was seen by Mr. Ormerod (December 1943) on account of slight hoarseness. He reported that her right vocal cord was irregular and infiltrated, the left vocal cord being congested. He regarded the condition as tuberculous and enjoined silence, and prescribed the usual creosote and cinnamon drops for use with a Burney-Yeo's inhaler. After some weeks the condition improved, and before she left hospital the cords appeared normal.

I did not see her again until September 11, 1944, when she was readmitted to Brompton with an extension of the disease to the right lung. From the report of the Tuberculosis Officer, Dr. J. T. Nicol Roe, under whose care she had been, it appeared that the pneumothorax treatment had been continued without much incident, the fluid effusion, which had at first shown signs of increasing, having been completely absorbed by the end of May. She remained apyrexial and gained weight up to the middle of June, but on June 28 she had a relapse with considerable pleural pain on the right side and fever, the latter persisting until about the middle of July when the temperature had fallen to normal and remained so. X-ray examination then revealed a fairly extensive infiltration of the right middle and lower zones. In the circumstances Dr. Roe felt that it seemed desirable to allow some re-expansion of the left lung, and at the same time to perform a right phrenic crush, as he was doubtful of the possibility of getting satisfactory control by a right A.P. in view of the recent clinical evidence of pleural

FIG. 10.—AFTER THORACOTOMY. THE OPACITIES AND IRREGULARITIES OF THE RIBS OBSCURE THE DETAIL OF THE DORSAL SPINE.

FIG. 11.—LATERAL RADIOGRAPH OF SAME CASE AS FIG. 10, SHOWING SPINAL CARIES WHICH HAD BEEN OVERLOOKED BEFORE THE THORACOTOMY.

See page 4.

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PLATE VI

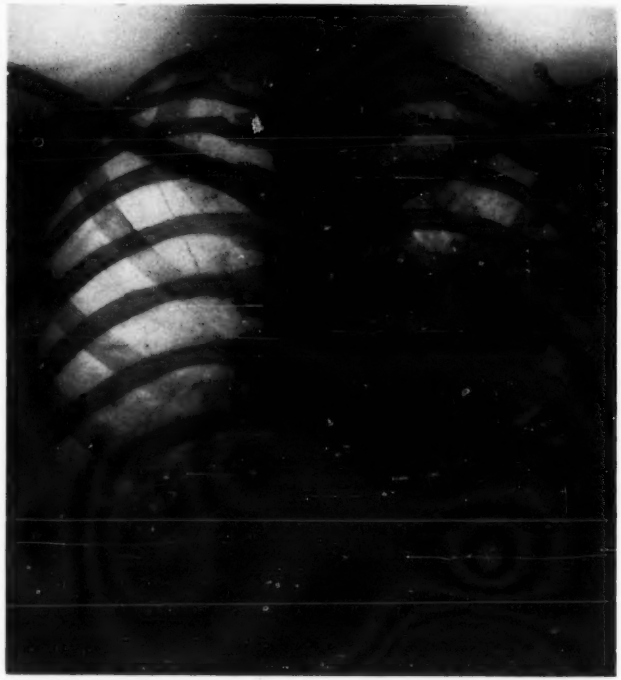

FIG. 1.—RADIOGRAPH OF OCTOBER 26, 1943, SHOWING HEART DISPLACED TO THE LEFT; INFILTRATION OF MIDDLE AND LOWER ZONES OF LEFT LUNG; NO INFILTRATION OF RIGHT LUNG.

FIG. 2.—RADIOGRAPH OF JANUARY 16, 1946, SHOWING BILATERAL PNEUMOTHORAX. HEART COMPLETELY DISPLACED TO THE LEFT; MASSIVE COLLAPSE OF LEFT LOWER LOBE; THICKENING OF PLEURA.

involvement on this side. The phrenic crush was accordingly done, and the right side of the diaphragm was later seen, on screening, to be paralysed.

On admission to Brompton on September 11 she was a little dyspnœic, but the temperature was normal. The sputum was T.B. positive. No abnormal physical signs were present on the right side of the chest, but X-ray examination showed an obvious extension of the disease on the right side. Comparison of the Brompton film with that taken the previous July, which Dr. Roe kindly sent for my information, made it clear that a good deal of the infiltration which was evident at the onset of the acute phase had resolved with rest, but there was still an extensive shadow in the right lower zone, suggestive of a recent lesion of exudative type. In view of the suddenness and severity of the clinical manifestation of this spread, I felt it was still worth while to attempt a right A.P., and this was accordingly done on September 30. Contrary to expectation, the induction was carried out without material difficulty (−10, −2, . . . 300 c.c. . . . −7, −1); an effective pneumothorax was obtained on the right side, and the patient was discharged home on November 29. It may be remarked here that the radiologists in reporting on her after the right pneumothorax had been established called attention to the fact that the left lung was now obscured by the cardiac displacement.

For about twelve months she appears to have continued in very fair health, but towards the end of 1945 one of the periodical radiographs gave rise to a suspicion of the presence of a small cavity in the right lower zone, and it was thought desirable to readmit her for assessment and to decide whether it was necessary to repeat the right phrenic crush. She was accordingly taken into Brompton for the third time on January 15, 1946.

On admission her general condition was good; she was afebrile and complained of no symptoms except an occasional productive cough which, though not distressing, was a source of continual inconvenience and embarrassment, as she was staying with friends or relatives. The sputum was still T.B. positive. Tomography failed to confirm the suspicion of a cavity in the right lower zone; the X-ray appearances in the ordinary film are illustrated in Fig. 2 (Plate VI) (January 16, 1946).

It was at this point that I was impressed with the fact that the cardiac displacement had been a prominent feature throughout, and in view of this I queried the possibility that she might have a tuberculous tracheo-bronchitis and asked my colleague, Mr. Price Thomas, to bronchoscope her. This he did, and reported as follows (January 31st, 1946): "Very small trachea, with red œdematous mucosa; carina difficult to find, owing to almost complete stenosis of the left main bronchus, flush with the trachea: painted with 10 per cent. solution of silver nitrate."

In view of the above findings it was obvious that re-expansion of the left lung in any circumstances was not to be anticipated, and that the only object in continuing to give refills on the left side would be to prevent the discomfort which she might otherwise experience from the purely mechanical effects of the cardiac displacement. Actually, however, no further refills have been given, and she appears to have adapted herself to the present conditions, the latest radiograph (October 22, 1946) indicating that the left pleural

cavity is practically obliterated. Apart from slight occasional dyspnœa she does not suffer any material physical discomfort.

The bronchoscopy was repeated as a matter of interest on October 21 last, the report from Mr. Price Thomas being as follows: "Trachea congested; carina not properly visualised, as there was a stenosis of the left main bronchus up to this level; the orifice would barely admit the end of a lead pencil; no active ulceration seen."

No operative procedure was contemplated and she is leading a quiet life at home, the refills on the right side being continued at weekly intervals.

Comment

The above account is a précis of all the notes of this case from 1938 up to the present, and should suffice to give an adequate presentation of its main features. Looking at the clinical and radiological details in retrospect, one is struck with certain phenomena which, though they failed to attract special notice at the time, now appear of greater significance.

In the first place it is interesting to note that when this girl was first examined at the age of 18, because of a suspicious cough, although no abnormal shadows were seen in the lung-fields, the radiologist did observe that the heart was slightly displaced to the left. This does not seem to have occasioned any further comment, nor are there any other features in the radiograph of that date such as would seem to account for the cardiac displacement (it was certainly not due to faulty centring), and yet this feature persisted throughout and was only investigated at a much later period, mainly in order to explain the continued presence of tubercle bacilli in the sputum, although the presence of cavities had been excluded, and the activity of the pulmonary lesions appeared to be satisfactorily controlled by collapse therapy. In the radiograph of January 1946 (Fig. 2, Plate VI) the displacement of the heart and mediastinum to the left is gross, doubtless increased by the traction of fibrous tissue from pleural involvement on the left side and by the pneumothorax on the right. In the light of the bronchoscopic evidence as to the state of the main bronchus, with the corollary of massive collapse of the left lung, it is interesting to speculate as to when the broncho-stenosis first began to occur, and what bearing, if any, the visceral displacement seen in the 1938 radiograph, 4 years before the appearance of any definite evidence of active tuberculosis, has upon this aspect of the case.

The refill notes for the L.A.P., sent to me by Dr. Roe, for the period May to August 1944, are possibly of some interest in this connection; the following five may be quoted.

May 28	– 12;	– 5;	...	450 c.c.	...	– 6;	0;
June 8	– 11;	– 5;	...	500 c.c.	...	– 5;	0;
June 22	– 10;	– 5;	...	500 c.c.	...	– 4;	– 1;
July 14	– 14;	– 6;	...	600 c.c.	...	– 3;	0;
August 8	– 30;	– 16;	...	200 c.c.	...	– 23;	– 11.

On all these occasions one is struck by the tendency to a greater negative pressure in the pleural cavity than would, perhaps, have been expected after fairly large refills such as these. The final pressure of – 23; – 11; would suggest

that a considerable degree of collapse of the left lung must have been present and that the broncho-stenosis must then have been extreme. Such a process must have been of long duration, possibly even dating back to some period prior to 1942, when the diagnosis of pulmonary tuberculosis was first established.

Bronchoscopy in this case was carried out only at a late stage in the course of events; any suggestions, therefore, as to the condition of the main portions of the bronchial tree at a much earlier period of this girl's clinical history can only be speculative. Tracheo-bronchitis as a complication of pulmonary tuberculosis is now generally recognised; its incidence in other pulmonary diseases has received less attention and investigation, though a certain amount of information is available. E. B. Kay (*Arch. Int. Med.*, 1945, lxxvi, 93) has found it in association with numerous cases of atypical pneumonia. In 150 patients who underwent bronchoscopic examination for various conditions, 29 were found to have ulcerative lesions of the tracheo-bronchial tree. Various non-tuberculous diseases are included in his series; in 9 of his patients there had been a previous attack of atypical pneumonia, and it is with these that Kay's communication is chiefly concerned.

No previous history of pneumonia was obtained from this girl, who does, however, appear to have suffered from bronchitis. I am not prepared to supply a complete explanation of all the phenomena of her case; this I must leave to the ingenuity of the reader, for whom, however, I hope this brief record may provide sufficient material for interesting discussion.

THE TREATMENT OF "TENSION CAVITIES"*

By ANDRÉ BERNOU

Châteaubriant

The classical observations on spontaneous and rapid changes of cavity size, on cavity distension under pneumothorax and on acute distension under thoracoplasty, led to the conception of intra-cavitary pressure changes capable of creating such conditions. In order to account for them many theories were put forward. Here, I shall only mention the single mechanism still admitted by nearly all phthisiologists: expiratory trapping in the cavity of air aspirated during inspiration, owing to an intra-bronchial narrowing. The latter may result from bronchial kinking, from intra-luminal sticky pus, exceptionally from a blood clot, more often from a fibro-caseous plug or an œdema of the bronchial mucous membrane. Also the obstruction may be caused by a caseating tuberculosis of the draining bronchus or by a proliferating or cirrhotic tuberculous bronchitis. This may be located at the broncho-cavitary junction with obstruction favoured by the obliquity of the draining bronchus relative to the cavity wall. As long ago as 1923 Ameuille emphasized the frequency of such a tuberculous bronchitis, and since then it has been confirmed by numerous observers.

* A résumé of a paper read in opening a discussion on this subject at the Annual Meeting of the Tuberculosis Association at Oxford, July, 1946.

Ameuille and Scheid also suggested that, apart from anatomical narrowing of the lumen of such bronchi, the significance of a lack of bronchial sensibility (and hence of cough reflexes) should also be considered, as well as lack of bronchial peristalsis and ciliary activity. Such alterations of the draining bronchial walls cannot occur without affecting condition in the cavities into which such bronchi open. Mille, Auerbach, Max Pinner and others have investigated the tuberculous lesions of the draining bronchial walls. Samson, Barnwell, Littig and Bugher, Cohen and Wessler, Salkin, Cadden and Edson, Overholt and Meissner, and Lemoine have shown by bronchoscopic studies how frequently the tuberculous lesions occur in main stem bronchi.

All these findings are significant as they support the hypothesis that bronchial narrowing due to thoracoplasty may aggravate a pathological stenosis of a draining bronchus and hence favour expiratory trapping of air previously inspired. Yet the literature suggests that some other mechanism may well be capable of creating a "tension cavity." As only an intra-cavitary pressure lower than atmospheric pressure could, according to this theory, allow air to enter the cavity from the tracheo-bronchial tract, there should never be a positive inspiratory pressure inside a cavity, at least during the deepest inspirations.

Most figures recorded by different workers support this view, but we must not forget that exceptions do exist. Fluid secretion occurring inside the cavity, the draining bronchi being closed, can account for these exceptions. A transient increase in the pressure of gases trapped in the cavity was recorded by Gernez when he injected into a cavity either artificial plasma or "diagnothorine" through its walls. But inspiratory excesses of pressure inside a cavity may have another explanation.

Without enlarging on this subject here the question whether coughing cannot play a part needs consideration. During the first expiratory phase of coughing, with the glottis closed, a dissociation of pressure between the two hemithoraces may occur momentarily, due to possible differences in the contractive power of their expiratory muscles. As a rise in the intra-bronchial pressure is transmitted from one side of the chest to the other, at least when there is no bronchial obstruction, we must conclude that a very high intra-bronchial pressure can exist at that time (Duplant, Rist, Bernou). This would favour the penetration of air into a cavity in spite of a narrowed draining bronchus, provided that the intra-bronchial excess of pressure could overpower the obstacle presented by the narrowed bronchus. If the obstruction was due to œdema or a fibrino-caseous plug more or less capable of being desintegrated and dislodged then this mechanism might well play a part.

When migration of air occurs on coughing cavity distension cannot occur, since the peri-cavitary parenchyma is affected by the excess of pressure during cough; but, during the following inspiration, a peri-cavitary tension-drop starts, as the bronchi connected with this parenchyma are not narrowed, and only a certain part of the intra-cavitary air escapes through the cavity wall. In spite of possible inspiratory widening of the draining bronchus the rather small difference between the intra-cavitary and intra-bronchial pressures is then, at any rate, much smaller than that created during the first phase of cough. It is therefore conceivable that a transient difference between

the intra- and peri-cavitary pressures may possibly occur and may result in cavity distension.

After a thoracoplasty, when the thoracic wall is stiff, there is practically no expiratory contraction of one hemithorax; so that the dissociation between the intra-cavitary and intra-bronchial pressures can be more significant. It is therefore apparent that a distension may occur, in spite of the thoracic wall collapse. It is impossible, however, to say for individual cases, without manometrical measurements, whether cavity reopening is due to such a transient excess of pressure, or to an intra-cavitary or intra-bronchial caseation.

Soon after a thoracoplasty the thoracic wall remains pliant; at that time the best conditions are existing for the creation of a cavity distension due to coughing, since there is neither contraction nor stiffness to counteract it. A few years ago Vivant and I observed that antero-lateral thoracoplasties with rib periosteum resection were most often responsible for post-operative acute distensions of cavities. Such distensions are favoured by mediastinal flutter or by simple " rebreathing," the expiratory distension of the draining bronchus being easier then.

Clinical observation has evidenced that this mobility of the mediastinum and of the operated lung is particularly noxious when the resections are mainly of the antero-lateral parts of the rib; for, behind this, flutter is more or less limited by the shoulder-blade. Such are probably the essential reasons for those " acute cavity distensions " which we observed with Fruchaud, a few years ago, when resecting antero-lateral rib segments with their periosteum.

The fact that such accidents are not seen so frequently nor so severely suggests that mediastinal flutter—also more exceptional nowadays—is, to a certain extent, responsible. Mediastinal flutter occurring with intra-pleural pneumothorax is not inverted with the respiratory thorax movements as happens in case of " flutter " due to thoracoplasty. Nevertheless, it possibly contributes to modify the air circulation through the broncho-cavitary system, by limiting the expiratory retraction of the draining bronchus.

Studies of the intra-cavitary pressures in taut-walled cavities, evidences that such cavities, in which a positive pressure does persist, are exceptional (Dumarest and Delord, Luzatto-Fegiz, Bernou, Gernez and Delwaulle). Most often, the pressures oscillate round zero. They can become negative when total bronchial obstruction occurs owing to the intra-cavitary resorption of gas (Coryllos).

Intra-cavitary pressure measurements have shown that distended cavities can remain distended even when the tension falls, if a transient excess of pressure has originated the distension. The presence of a fluid level inside a cavity by no means implies that a more or less partial intra-bronchial block, and hence an excess of pressure, is necessarily present. Therefore, the persisting real " tension cavity," such as described by Coryllos, is exceptional, and the therapeutic problem set by this type of cavity does not occur frequently. On the contrary the problem in cases of " balloon tension cavities " with partial or total block of the draining bronchi is perplexing, whatever the intra-cavitary pressure may be. We cannot solve it without a knowledge of the cause of the bronchial block in every case; but this is not always possible, even with the help of bronchograms, bronchoscopy or of tomograms.

Before dealing with the results of the various surgical treatments for healing cavities of the " tension " type as Coryllos saw it, I should like to draw attention to the fact that, most often, these results most likely refer to " taut-walled " cavities rather than to real " tension cavities."

Treatment of Giant Cavities

1.—*Thoracoplasty:* Coryllos has distinguished " giant cavities " and " round cavities." Among the 54 giant cavities I have treated by thoracoplasty, 33 of them apparently were " balloon tension cavities " and relatively well tolerated; the 21 others recalled the " open cavity " type.

Results obtained in the first group were particularly satisfactory. Seven recent cavities healed completely, but previous intra-cavitary suction drainage had been induced for 2 of them. Out of 13 very large cavities, stabilised for less than 2 years, 12 healed completely. Out of 13 very old thick-walled and well tolerated giant cavities, 7 healed by thoracoplasty alone, 5 only improved, but 4 of them healed after subsequent speleotomy following thoracoplasty.

Sometimes these results were obtained after cavitary distension under pneumothorax, confirming that thoracoplasty can often favourably modify the bronchial obstacle which resulted in a cavity distension under pneumothorax (Houghton).

2.—*Intra-cavitary Suction Drainage:* All phthisiologists who have used it these last few years have been much disappointed with suction drainage of cavities. The combination of thoracoplasty and intra-cavitary suction drainage permitted one, sometimes, through preliminary drainage, to perform thoracoplasty on patients whose poor general condition would not have warranted such an operation. But whatever may be the operative by-ways used, this combination still has many disadvantages and is far from having always the advantages that were ascribed to it.

Treatment of Round Cavities

The results of thoracoplasty for " round cavities " appeared quite as satisfactory as those achieved for others. Out of 305 cases treated some time ago, Le Carboulec and I had 54 with " round cavities." We found that 83 per cent. of them healed completely (45 of our cases). Of 136 irregular cavities, located in diseased parenchyma, 113 now seem lastingly healed—that is, 83 per cent. Of 115 ulcero-retractile lumps, 85 per cent. of them healed (98 of our cases).

Our thoracoplasty results on 137 patients whose cavities showed a fluid level gave 106 patients recovered completely—that is, 77·3 per cent. Failures could not be imputed to an intra-cavitary excess of pressure.

Is it necessary, as a few American authors have emphasized, to prefer pulmonary resection to thoracoplasty for the type of case we have been considering? This still appears to me very debatable. In spite of the progress of the last few years in pneumonectomy and lobectomy, the risks are still not negligible. Except in cases of infected bronchiectasis combined with tuberculosis, and perhaps of " blocked cavities " with unequivocal diagnosis, I prefer to rely on thoracoplasty, with the possibility, when there is a residual cavity, of doing a subsequent speleotomy which consists of wide surgical

opening of the residual cavity, cleansing its walls, cauterising the draining bronchus outlets, and eliminating caseating foci near the cavity. This has given excellent results in dealing with these difficult cases.

PULMONARY TUBERCULOSIS

EFFECT OF SEA VOYAGE ON 37 UNSELECTED CASES

By R. HAMBRIDGE

Sea voyages are rarely, if ever, prescribed for the treatment of pulmonary tuberculosis. When they must be undertaken they are more often regarded as harmful than beneficial, a view supported by many instances from the past. Life aboard either a pleasure-cruising merchantman or a troopship is far from that desired for active or quiescent disease.

In 1909 Hanedoes of Vaassen suggested a veritable floating sanatorium for all forms of tuberculosis. The *Lancet* (1909) acclaimed the idea in a leading article, but with reserve for pulmonary disease. Collapse therapy was in its infancy at this time and much importance attached to climatic benefits. But six years later, Jex-Blake (1915) wrote of long sea trips as unsuitable for any except cured tuberculous patients. He thought the airless cabins and impracticability of medical supervision were especially undesirable. A few years later Powell and Hartley (1921) gave much the same opinion, that " patients with active tuberculous disease should be strictly forbidden to take a sea voyage." However, a fashionable taste for ascribing therapeutic qualities to different types of air remained in vogue; and " delicate chests," a clinical state presumably including tuberculosis of low-grade or recurrent activity, were sent to sea. Summarising current views in 1937, Burrell remarked that " for a patient in fair general health a sea voyage may be a very healthy way of spending the winter "; but he condemned it for active disease. Jex-Blake stated clearly his objections to sea voyages, and although other writers have not been so precise, most of them seem to believe that benefit from sea air in suitable latitudes is largely offset by the lack of medical supervision and the disruption of a controlled régime. By 1939 even the sea air becomes an outcast, and climate is held to be of little importance in the treatment of phthisis, ranking as a last consideration (Kayne, Pagel and O'Shaughnessy, 1939).

During the recent war there has been a great increase in the number of known sufferers from pulmonary tuberculosis who have needed transport by sea, an increase due partly to better diagnostic facilities for combatants in distant campaigns. Most of these patients travelled on hospital ships and often made long and arduous journeys without detriment to their health. But when hospital ships and correct medical supervision were not available, material harm commonly occurred either in the course of a long voyage or after disembarkation. It was most often traced to an unwonted increase in the patient's activity, such as climbing ladders or stairs for normal daily functions; to neglect of rest hours or to lack of convenient nursing, feeding and recreational facilities; commonly to prolonged sunbathing (Hope Gosse and Erwin, 1934); unwise

exercise and deck games; and in some cases to re-expansion of a comparatively freshly established pneumothorax.

Although statistical evidence cannot be brought to support the contention, it is likely that improper living conditions and a lack of supervision are much more responsible for deterioration at sea than are factors such as latitude, altitude, air oxygen tension, or other variables (Kayne, Pagel and O'Shaughnessy, 1939). If conditions aboard ship compare favourably with those of a hospital or sanatorium, then the main difference, apart from a geographical one, is the continual movement. Providing the principles of good treatment are adhered to, a sea voyage should not present any great menace to the tuberculous. The progress of 37 Service and civilian patients who were sent by sea from Australia to the United Kingdom forms the subject of this paper: though not statistically significant, the results give good ground for believing that such is indeed the case.

The Ship and the Hospital Unit

In June, 1946, there were still personnel of the three Services, repatriated prisoners-of-war and civilian internees awaiting passage from Australia to the United Kingdom. As a hospital ship was not available, the remaining patients and staff from the Royal Naval Hospital, Sydney, were brought home by a fleet carrier of the Royal Navy engaged in trooping duties. She carried troops as well. In the few days between her arrival and departure from Sydney a hospital unit was built on the upper hangar deck, designed to give the best possible living conditions for the tuberculous patients compatible with segregation from other patients and from healthy troops also quartered on this deck.

The hospital unit occupied the area athwartships from the after fire screen to the after lift well: the flight deck formed the deck head and was very high, giving ample air space. Ventilation by four large exhaust vents was augmented by twenty electric fans spaced throughout the unit: the lift wells were kept constantly open to the flight deck. Each patient had a bed or bunk which was welded to the deck, and with each bed was a steel locker and over-bed table. Latrines, ablutions, sluices and sterilisers were situated on both port and starboard shipsides. A portable X-ray plant was mounted centrally in the unit. Artificial pneumothorax apparatus, all surgical instruments, X-rays, notes and other ward requirements were kept in a small duty cabin also in the unit. The several areas and individual wards—male, female, officers and ratings—were partitioned off with wire net and hessian on wood frames, without reaching to the deck or more than halfway to the deck head, to allow free circulation of air. The galley was on a lower deck, food being hoisted and brought by hand to the unit servery. All patients had wardroom diet supplemented by malted milk and other beverages, including a daily ration of 3 pints of glucose fruit juice. No fresh milk was obtainable, but sweets, biscuits and other Red Cross comforts were in liberal supply. Smoking was restricted to five cigarettes daily, after meals. All patients were wakened at 6 a.m., kept rest hours from 10 to 11 a.m. and 2 to 3 p.m., and were turned in by 8.30 p.m., with lights out at 9.15 p.m. Washing, blanket-bathing and other nursing followed naval hospital routine. A large staff was available,

and was indeed needed under the improvised conditions. A small pathological laboratory, a dark-room and a dispensary were established outside the unit.

The Voyage

Soon after putting to sea in Australian winter conditions, one of the worst gales for many years was encountered in the Tasman Sea. All weather decks were closed for two days and three nights, all movable objects were lashed down and speed was reduced from 25 to 8 knots. Most of those on board were sea-sick. In the tuberculous wards, where at gale warning all patients were put to bed if up, not one was sea-sick; even those patients who, prior to embarkation showed nausea and vomiting as a tuberculous manifestation, complained of no aggravation of these symptoms. No preventive therapy was attempted other than rest in bed.

In the Great Australian Bight the weather remained cold and the seas high, while the flight deck, a portion of which was the only deck space available to patients, was swept by a 40-45 m.p.h. head wind. For the first quarter of the voyage all patients therefore remained entirely below deck. The Indian Ocean was crossed at the time of the monsoon, the prevailing wind being astern. In these hot, humid conditions all bed patients were placed on stretchers at the bedside, carried to the lift and hoisted to the flight deck as soon after 7 a.m. as was practicable. Here they spent the forenoon on stretchers under an awning rigged amidships. This regular daily feature was most popular, and appeared to contribute greatly to their morale, already high with the ship bound for home. The tedium of hours spent at rest was enlivened by the marines' band at divisions, the bosun and his working party rigging a swarming net, catching a glimpse of a former messmate, or even just watching the sun and the sea; and the cool breeze had beneficial qualities. In the afternoon light recreational therapy was provided for suitable patients in the hospital unit.

As near to a normal sanatorium routine as possible was attempted. Rest, collapse therapy and other measures were maintained, and ambulatory activities were continued for those patients who had reached this stage. Screening was not practicable, so all pneumothorax refills were controlled by X-ray films. In a ship which moves and vibrates as much as a carrier at speed, blood sedimentation tests are unreliable and so were not attempted.

Progress of Patients

In the group of 37 patients, all stages of disease were represented, ranging from unchanging minimal radiological abnormalities to far-advanced bilateral cavitation with tuberculous laryngitis and fistula in ano. The following table shows the sex distribution, the numbers ambulant and in bed, and the numbers with an artificial pneumothorax.

	Male.	*Female.*
Total	32	5
Ambulant	12	5
Bed	20	—
Artificial pneumothorax	14	1

Of 37 patients, using the classification of the National Tuberculosis Association of America, the group comprised:

(*a*) Nine minimal cases. The lesions were quiescent in 4 and active in 5. All were within the 20-30 years age group, and their general condition was good or excellent.

The only demonstrable clinical change while at sea in any patient in this group was an improvement in one patient's tachycardia. No one became worse.

(*b*) Eighteen moderate cases. Three of these had quiescent and 15 active disease. The majority fell within the 20-30 years age group, and most of them were in good or excellent general condition. Four were in poor condition. Nine in this group had an artificial pneumothorax, but in all of these the disease was still active or too recently controlled to be quiescent.

Clinical changes noted in this group of patients were more numerous. Two of them, undergoing collapse therapy and unimproved at embarkation, showed radiological cavity closure one month later; one became symptom free; another achieved a negative sputum; two became afebrile; two achieved a normal pulse rate; and three, not previously gaining weight, did so while at sea. No cases became worse or died.

(*c*) Ten far-advanced cases. All these had active disease, all had symptoms of varying grades of severity, and all had abnormal physical signs with persistently positive sputum, pyrexia and tachycardia. The majority were in the 30-40 years age group. Six of them had an artificial pneumothorax and three a phrenic nerve crush. More than half were in poor condition, and four had a tuberculous laryngitis, and one a fistula in ano, too, complicating the pulmonary disease.

Rather remarkably, considering the trying voyage, none of these patients, with one exception, lost ground during the 29 days at sea; and none died. Two not gaining weight at embarkation subsequently started to do so; the one patient who lost ground showed marked deterioration both radiologically and in his general condition.

Effect of Humid Heat on Two Gravely Ill Patients.—Two patients had shown a slow but progressive deterioration for several months prior to embarkation and had been refused passage by hospital ship at an earlier date as too ill to travel. Both had far-advanced disease with cavitation in at least three zones of the lung fields and pneumonic consolidation. They had both been prisoners-of-war and, besides severe toxæmia, were wasted almost to emaciation. Both had tuberculous laryngitis and one a tuberculous fistula in ano in addition.

After 72 hours of increasingly humid heat with air temperatures ranging from 82° to 90° F. throughout the 24 hours, and humidity of 74 to 80 per cent., these two patients were very pale, intensely dyspnœic, distressed and sweating. Their pulses were thin and rapid. Neither had eaten for eight hours, and one was suffering considerable nausea. They were moved immediately to the operations room on the bridge, where air-cooling was possible. Air temperature of 70° F. was attained over the ensuing two hours and thereafter maintained. Both patients very quickly improved, and they remained in this room until the outside air temperature had fallen to 70° F. and the ship had

cleared the sub-tropics. They then returned to the hospital unit, where for the remaining four days their progress was uneventful.

Discussion

It is often important for a tuberculous person to know whether, by taking a sea voyage, his health may suffer. Those who have to advise on such an undertaking have little guide, apart from the points already mentioned, and a knowledge of the tenets of treatment and prognosis. A small group such as this, studied in varying and inclement conditions, and in the complete absence of controls, adds very little, of necessity, to what we know. But perhaps a few comments are permissible.

In the first place, there was little clinical evidence of anything dramatic in the "tonic" qualities of sea air for the tuberculous. This confirms an impression which is widely held nowadays. Certainly there was nothing to justify such a project as a floating sanatorium, with its multitude of staffing and victualling problems.

Patients with quiescent pulmonary tuberculosis appear to travel just as safely by sea as those in normal health when following the same régime afloat as ashore. If quiescence has been achieved by means of collapse therapy, then this must be maintained by the same standards as it was achieved.

Another important matter is that active disease demands the same close medical supervision and efficient nursing at sea as it does in any normal environment: if this is attained, neither more harm nor greater benefit is likely to happen than would occur in a sanatorium ashore. The sole exception is the patient so gravely ill that even transient extremes of heat and humidity may make such a move dangerous or even fatal.

Summary

An account is given of the transport by sea, in improvised hospital ship conditions, of 37 unselected Service and civilian patients with pulmonary tuberculosis.

Clinical observations during a voyage of 29 days in adverse climatic conditions gave reasons for thinking that in none of the patients was the course of their illness affected one way or the other by the voyage.

The effects of humid heat on two gravely ill patients are described.

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ON SELECTING TREATMENT FOR THE PATIENT WITH PULMONARY TUBERCULOSIS

By J. LEIGH COLLIS
From a Military Hospital

Introduction

When there is no specific drug for a disease, selecting the correct treatment and using it at the right time is a rather complicated matter. This is certainly true of pulmonary tuberculosis. Decisions of paramount importance need to be made, and failure to give them sufficient thought is probably the cause of more bad results than any other single factor.

For the past year I have been working in the organisation set up to deal with tuberculous patients from all the Commonwealth's Forces in India. Although the number of patients in the three hospitals concerned has varied, the total exceeded two thousand for much of the time. Co-operation with the various physicians made it possible for me to see a very large proportion of these patients, in addition to the two hundred and fifty actually in the surgical division. The opportunities for learning from the successes and failures were very great, and I feel they have done something to crystallise my own ideas on the treatment of the disease. The present paper is intended to convey the effects of that experience upon my own views for the interest—and criticism—of others.

Case Selection

This paper deals primarily with disease of the pulmonary parenchyma; reference to tuberculous empyema is made only in so far as it affects the main theme. So far as a decision on treatment is concerned there are seven separate and distinct aspects of any case which must be kept in mind when decisions are made. I propose to deal with each of these seven aspects individually.

1. *The Disease Itself.*—Consideration of the actual disease present should be made from five points of view:

(*a*) *The Type of Disease.*—By this is meant the degree of activity of the lesion. Marked activity is a warning sign when collapse therapy is contemplated. Certainly some benefit from rest and relaxation may be obtained; but at the same time consolidation will be produced, which will involve not only the actively diseased lung, but also normal, or relatively normal, tissue surrounding it. This consolidation may lead to spread of the disease, frequently carrying it to the surface where the pleura is not adherent, and so causing fluid or a pyothorax. Also it makes the walls of cavities more solid, and may well result in cavities enlarging and becoming intractable to any form of therapy. But if, on the other hand, the disease be showing signs of healing, collapse therapy offers its advantages without any of these dangers. Even if it should lead to massive collapse of a part of the lung this should not be confused with consolidation, and would not have the same disastrous effects.

If, therefore, the disease is in an acute stage, strict rest treatment is required, and not collapse therapy until this stage is passed. For an active apical lesion

even a phrenic crush is not advised, however hopeful one might be that this would improve the lesion and allow a thoracoplasty later. Too often this minor therapy has resulted in local spread, and general signs of retrogression which have only been overcome by a long period of subsequent rest. Rest treatment would have served its purpose much more easily without this supposed aid.

(*b*) *Extent of Disease.*—Quite apart from any other factor, this must play a big part in any decision about treatment. Disease of small extent has a better chance of healing with less external help than disease which is more widespread, so that automatically and rightly simpler measures are preferred. Even if collapse therapy is employed for a small active lesion, this causes only a relatively small amount of consolidation. At least the disease is not made worse. If, however, the disease is of greater extent the risks of precipitate action will be steadily magnified.

(*c*) *Patient's Resistance.*—An assessment of the clinical data about the patient, including his family history, provides some idea of his resistance. Here it is important to pay regard to the conditions under which the patient " broke down." The importance of this was well shown by our repatriated prisoners, who fared much better from simple rest and an adequate diet than might have been expected.

A patient with a poor resistance needs greater care and conservatism in treatment rather than an immediate embarkation on some radical measure. In the extreme case with no natural resistance, no therapy at present available makes any difference to the eventual result. This was clearly demonstrated in some of our Gurkha patients by necropsy studies.

(*d*) *Progress of Disease.*—This must be clearly differentiated from the patient's natural resistance, as so many other factors may be responsible for poor progress up to the time of examination. Quite apart from extent or any other factor, the ideal time for instituting collapse therapy is when a lesion is already improving. If one can be certain of this there is little danger in proceeding to whatever form of collapse therapy the other factors in the case make suitable. If, on the other hand, the disease is retrogressing, the need for rest and conservative treatment is paramount to reverse this process before further action is taken. The third possibility is that the lesion may have remained stationary for a long time. Here, I think, is another indication for further action. It can at least be said that the disease is not worsening, a strong hint of powers of resistance, even though they are insufficient to heal the lesion without outside help.

(*e*) *Bilateral Nature.*—Of itself a bilateral character of the disease is of little significance in prognosis. There can be no doubt that a patient with chronic bilateral lesions is a much better life than one with acute unilateral disease, although the extent of the latter may be much less. However, bilateral disease has a very definite bearing from several aspects. First, disease on one side may be making the contralateral disease worse by the mechanical stretching of a displaced mediastinum. It is often found then that the lesion on one side is chronic and fibrosing, and the contralateral disease is of less extent and more acute. The indication here is immediate action by pneumothorax treatment on the lesser and more acute lesion. This may seem to contradict what has already been said, but this is not really the case. The pneumothorax which

is induced will be of a shallow or mantle type, and, as the mediastinum is displaced, it will only have the effect of returning the lung to its normal size. Its sole effect will be to prevent over-distension, and thus will not carry with it the dangers of consolidation already described. After all, the patient has strong powers of resistance, as shown by the fibrotic lesion on the primary side; while the disease in the contralateral lung has advanced only when subjected to the over-distension resulting from mediastinal displacement. This, then, is the one time when an acute lesion may be treated by a pneumothorax, but it must be in the circumstances described—that is, a lesion, usually apical, being stretched by a displaced mediastinum. This statement does not apply to bilateral disease with a central mediastinum nor to a broncho-pneumonic basal spread in the contralateral lung. In these two instances rest and conservative measures will be indicated. Where a contralateral pneumothorax of shallow or mantle type has been used, such a patient will later need the primary side treated by thoracoplasty.

The second way in which bilateral disease affects the decision is that there is a danger that the contralateral disease will be made worse by the institution of collapse therapy on the primary side. This danger is more real when the contralateral disease is of a relatively acute type, and the indication here is to treat this contralateral disease first. This may be done by rest or with a contralateral pneumothorax as already described. If, however, the disease on the contralateral side is chronic, and particularly if it is in the upper zone, it does not run the same risk of spreading following collapse therapy on the primary side. In these circumstances even a thoracoplasty may be done without special attention being given to the contralateral disease.

2. *The General Condition.*—A toxic and emaciated state usually goes with low resistance and actively progressing disease. It is necessary then to be certain that the patient has at least some resistance before collapse therapy is started, otherwise there is great danger of subjecting the patient to more discomfort than his disease already provides. More important in considering the general condition are those patients who have some resistance but who are nevertheless emaciated. Here again conservatism is usually the best line at first. It is rare for any other treatment to succeed in a patient whose general condition will not improve with careful rest. Even pneumothorax therapy should not be rushed in such a case, although the simplest types of collapse therapy may be started as soon as some gain in weight is registered.

Often it is said that delay in starting pneumothorax therapy allows adhesions to form, and loses the only hope of a satisfactory collapse. This is a fallacious and dangerous line of thought. If there is disease adjacent to the pleura likely to cause pleurisy and adhesion, then fluid and other complications after pneumothorax treatment are prone to occur, and such treatment will be a failure in any case, and may lead to disaster.

Under this heading may also be considered the presence of associated diseases. The most important of these is diabetes mellitus. Control of diabetes requires great care as well as slower, more prolonged and greater relaxation for any disease present than would be required with a similar non-diabetic patient.

3. *The Existing Mechanical Deficiency.*—This is particularly important when

collapse therapy is considered, for the various forms available each offer a slightly different effect. If fibrous contraction during healing produces a vertical pull the relaxation given by a phrenic interruption with or without a pneumoperitoneum will help. But if the pull is mainly horizontal such treatment has little effect. Anything in the way of treatment which shortens the distance from apex to base will have no effect on the pull from the mediastinum to the chest wall, as there is no resolution of a force at right angles. An example of this is fibrosing disease occupying the whole apex of one lung, and causing marked displacement of the trachea. The general condition may be good, symptoms few and the B.S.R. low; but no useful purpose is served by a phrenic interruption, and if a pneumothorax is impossible, a thoracoplasty will be necessary. This patient requires relaxation in the horizontal direction, and if some circumstance such as contralateral disease should forbid an immediate thoracoplasty, then the only way to achieve some relaxation in this direction is to do a contralateral pneumothorax. This allows the mediastinum to shift further to the affected side, and frequently provides good treatment for both lungs. In this state of affairs it may occasionally be justifiable to try a contralateral pneumothorax, even when no disease exists on the pneumothorax side.

When adhesions are present in a pneumothorax it is generally agreed that perfect relaxation is only affected if the adhesions be divided. Adhesion section, however, is often not possible, or may seem rather a gross form of interference in some cases with mild disease. It is reasonable then to consider a phrenic in association with the maintenance of the pneumothorax. But it must be remembered that full possible relaxation will already be present if the lung is free from the diaphragm, and that only when the lung is adherent to both diaphragm and apex will any further benefit be derived from this combination of treatments.

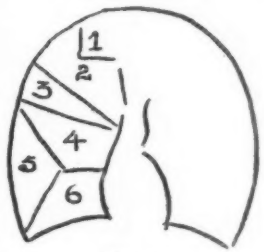

FIG. 1.

4. *The Position of the Disease.*—In making the choice of the most suitable treatment for a given patient, I divide the chest up into six areas, according to the position of the disease. I will list these, and then consider each in more detail (Fig. 1).

1. Apex—A.P. or Thoracoplasty.
2. Subapical—A.P., Phrenic Interruption, Thoracoplasty.
3. Lateral apical—A.P., Phrenic Interruption, Pneumoperitoneum or Thoracoplasty.
4. Mid-zone—Phrenic Interruption, Pneumoperitoneum.
5. Lateral base—A.P., Phrenic Interruption, Pneumoperitoneum.
6. Basal—Rest; Lobectomy.

I appreciate that these positions may appear to be over-simplified—that, for instance, at least a lateral view should be added. I admit this criticism, but maintain that the simple plan covers so many of the eventualities that it is better not to complicate it further.

In Area 1 there is disease at the extreme apex which is likely to stretch from the medial to the lateral surfaces of the lung if it is of any extent. Vertical

relaxation alone is unlikely to be much help for this; if any collapse therapy be necessary, a pneumothorax or a thoracoplasty will be required.

In Area 2 is the commonly affected subapical region. Here, although pneumothorax or thoracoplasty would usually be preferred, phrenic interruption may be beneficial. In this situation there will at least be some functioning lung tissue above and below the lesion so that, if vertical relaxation be provided, the healthy tissue may occupy the space previously taken by the now fibrosing lesion.

Disease in Area 3 usually affects the lateral broncho-pulmonary segments of the upper lobe. They are found in a higher position than normal because the diseased tissue has contracted towards the rest of the upper lobe. If the disease is slight, further aid to this upward contracting process will be good treatment, and may be provided by a phrenic crush or a phrenic crush and pneumoperitoneum. But, if the disease is extensive, horizontal relaxation will also be necessary, requiring pneumothorax or thoracoplasty.

Disease in Area 4 will be found on a lateral film to be in the posterior part of the lung, and is actually in the apex of the lower lobe. In this situation the lesion is more frequently truly apical than in the upper lobe, so that there is less chance of surrounding lung tissue aerating and occupying the area of disease. Further, the apex of the lower lobe is so close to the hilum that the possibilities of relaxation are minimal. In consequence pneumo-thorax treatment is frequently very disappointing, and is probably better not attempted, at any rate in the first instance. Functional rest can be provided better by a phrenic crush or evulsion with or without a pneumoperitoneum.

In Area 5 there is disease affecting the lateral segments of the lower lobe or the lateral segments of the upper lobe where there is no tendency to relax upwards. Pneumothorax, phrenic interruption or pneumoperitoneum may be used here, while thoracoplasty will be impracticable because of the excessive amount of normal lung which will have to be collapsed before the diseased area is reached.

Area 6 is the difficult area of the anterior and posterior basic segments. As all the bronchi in this area are dependent, there is a great tendency for consolidation to occur, even if the disease should not be very acute. Any form of collapse therapy is likely to increase this tendency, and so all are equally bad and should always be avoided. The ideal treatment here is undoubtedly lobectomy, but if this be impossible owing to disease elsewhere, one must rely on rest alone.

5. *The Secondary Mechanical Defects.*—Some patients would appear by all tests to have a good resistance, and yet for various reasons their progress is unsatisfactory. These patients need careful assessment, for premature collapse therapy may do much harm. They fall into two groups. First, and more important, are those with excessive cough, and secondly those with a valvular action in bronchi draining cavities. The underlying cause in the first group is usually tuberculous bronchitis, although secondary infection may be playing a variable part. In addition to the excessive cough, these patients are recognised by the irregularity of their temperature and excessive physical signs out of proportion to the radiological appearances. The mechanical effect of the cough tends to keep cavities open and throw extra strain on the lung. Together

with the bouts of pyrexia this prevents any improvement in general condition, in spite of a good natural resistance. These patients might do well with pneumothorax therapy, but almost always this is prevented by adhesions, while their general condition and the lesion forbid thoracoplasty. Such a case would seem to have the best indications for Monaldi's cavity drainage.

The problem of the tension cavity is a difficult one. The previously accepted criteria of a round shadow on the skiagram and a positive pressure on introducing a cavity needle are most fallacious. They may vary from week to week. If they are to be accepted as the sole indication for cavity drainage they should be repeated several times before action is taken. In any case cavity drainage should only be embarked upon with the knowledge that treatment will be long, and will almost invariably require thoracoplasty at the end. Used in this way and not as a short-cut to cure, it is a valuable adjunct to treatment.

6. *The Problem of Cavitation.*—It is true to say that in the past too much attention has been given to the vacant space of cavities without sufficient regard to the surrounding disease, and perhaps also to the secondary mechanical effects. After all, it is the disease that requires treatment. Even after successful thoracoplasty cavitation frequently still exists.

In general cavities fall into two groups depending on the state of the surrounding lung. In the first group is cavitation in acute disease, where caseation is much to the fore. Collapse therapy in such cases causes massive consolidation around the cavity. This is sure to spread the disease and to give great danger of serious complications. In this group, therefore, cavitation is a contra-indication to collapse therapy. In the second group are cavities surrounded by chronic disease. Here they are hindering satisfactory healing, and are an added indication for the institution of collapse treatment.

7. *The Respiratory Efficiency.* The prospects of patients with a markedly reduced vital capacity are very poor whatever treatment is used. Spirometric readings under 1500 c.c. are dangerous; but the real test is the functional one, and if a patient can converse easily, his functional reserve must be sufficient for the purposes of treatment. Many patients with respiratory insufficiency have lesions which, on other counts, seem to be calling for collapse therapy; but the results will be universally bad, and it should never be used.

Discussion

Consideration of the various factors which have been discussed shows that there is no place for precipitate action in the treatment of pulmonary tuberculosis. Furthermore, " doing something " for no other reason than to do something is likely to give the worst possible results. Every problem must be considered individually before treatment is mapped out for a patient. But dangerous treatment of patients who are bad risks does sometimes give results far in excess of expectations. This sort of thing, however, should be undertaken only by the very experienced, with a full realisation of the risks that are run.

Though the treatment of pulmonary tuberculosis may be altered by new drugs, consideration will still need to be given to what we can already do. For it is likely that mechanical difficulties will still be a stumbling-block to healing in many cases.

Summary

In considering treatment for pulmonary tuberculosis there are seven important matters for assessment: the disease itself; the general condition of the patient; the existing mechanical difficulties; the position of the disease; the secondary mechanical defects; the occurrence and nature of cavities; and the respiratory efficiency. Only after careful consideration of the disease from all these angles can a satisfactory plan of treatment be achieved. If there is still doubt after such a review it is generally better to continue conservatively rather than try other treatments prematurely.

MEETINGS OF SOCIETIES

JOINT TUBERCULOSIS COUNCIL

At the last meeting of the Joint Tuberculosis Council, the Chairman welcomed Dr. George Fletcher, representing the North-Western Tuberculosis Society.

It was reported that a deputation had met Sir Arthur Rucker, Sir Wilson Jameson and others, to discuss new arrangements to replace those contained in Memorandum 266/T. Ministry of Health Circular 114/46 was also discussed. Sir Arthur Rucker said that the Government fully accepted the argument that the tuberculous family had special needs. The same case, however, could not be made out for non-pulmonary cases as for pulmonary cases. Local health authorities would be obliged, under the new Act, to undertake care work, and they would be able to give some forms of assistance in kind. Sir Wilson Jameson said that consideration would be given to the deputation's request that 266/T allowances should be improved pending the introduction of new proposals. (*N.B.*—A full report of this interview will shortly be circulated to the medical press by Dr. C. K. Cullen, leader of the deputation.)

The Council adopted a report dealing with the National Health Services Act and ordered it to be forwarded to the Minister of Health's Standing Advisory Committee on Tuberculosis. The report is not being issued as a Council publication at present, as it may be amended at a later stage. Generally, it may be said to emphasise the Council's view that tuberculosis is a disease requiring a special organisation, and it puts forward proposals for meeting this requirement within the framework of the Act. Further details will be available later.

The Committee on Nutrition reported that they had considered the question of the effect of bread rationing on tuberculous persons in and out of hospitals and sanatoria, and they had also considered whether the time was opportune for a fresh investigation of dietaries for the tuberculous. They had, however, come to the conclusion that no action was required at present on either subject.

A circular was recently sent out by the Council to its members asking for information about the disposal of old records of tuberculous patients. Thirteen replies had been received. It appeared that seven authorities retained the records of dead patients indefinitely. The others destroyed them after periods varying from 2 to 20 years. Only five areas said they transferred the original documents when patients were moved to other areas.

The Council decided to invite Dr. B. R. Clarke of the Northern Ireland Tuberculosis Authority to fill a vacancy among the co-opted members of the Council, caused by the resignation of Dr. J. B. McDougall.

NOTICES

THE DISABLED—A PROGRESS REPORT

An account of steps to help the disabled to take their place in the working life of the community is given in a Report* presented to the Minister of Labour and National Service and published recently.

The problem of disablement, with its several aspects—medical, social and industrial— is now recognised to be a single problem; and the various stages in its treatment, from "rehabilitation" through "reconditioning" to "resettlement," are regarded as parts of one continuous process. This present-day view of the problem is reflected in the Report.

It begins with a synopsis of progress in medical rehabilitation, followed by references to certain particular classes of disablement; it then summarises developments in bridging the gap between completion of hospital treatment and readiness for training or full-time activity; and it outlines the steps—registration, the quota scheme, designation of employment, employment under special schemes, and so on—now used to resettle disabled persons as self-supporting members of the community.

The Standing Committee, consisting of representatives of the Government Departments concerned, was formed, after a recommendation in the Tomlinson Committee Report, to secure some general supervision over the development and administration of the schemes proposed for the rehabilitation and resettlement of disabled persons. As regards medical rehabilitation the Report gives figures showing the substantial increase since 1943 of the number of hospitals in England and Wales with facilities for active rehabilitation—150 in 1943 to 333 in 1946. The progress made in Scotland is also briefly described. The Report outlines the measures taken to deal with cardiac cases, tuberculosis, deafness, psychoneurotic persons, and the rehabilitation of miners. A special scheme is also mentioned for the provision of artificial limbs to persons not entitled to free issue under Government schemes; some 3,000 persons have been supplied with limbs under that scheme since it was started in October 1942.

The Tomlinson Committee's main recommendations about *Reconditioning, Vocational Training and Resettlement* are included in the Disabled Persons (Employment) Act, 1944. The Act authorises the provision of vocational training and industrial rehabilitation courses for disabled persons, the cost to be met out of public funds. A statement of the facilities available for vocational training and industrial rehabilitation is given.

Reference is made to the start on September 25, 1945, of the *Register of Disabled Persons*, maintained at Local Offices of the Ministry of Labour and National Service; up to August 19, 1946, the number of registered disabled persons was 628,638. Registration is a condition of eligibility for the "employment" schemes under the Act. These include (i) the *Quota Scheme*, which places an obligation on employers of 20 or more workers to employ a "quota" of registered disabled persons based on a standard percentage (at present, 3 per cent.) of their labour force; (ii) the *Designated Employments Scheme*, under which the Minister has so far designated the employments of passenger electric lift attendant and car park attendant as specially suitable for disabled persons; and (iii) schemes for providing *facilities under "special" (or sheltered) conditions* to meet the employment and training needs of registered

* Report of the Standing Committee on the Rehabilitation and Resettlement of Disabled Persons. H.M. Stationery Office, 1946. Price 4d. net.

disabled persons who, because of the nature or severity of their disablement, are unlikely to get employment under ordinary conditions. In connection with (iii) the Minister has set up the Disabled Persons Employment Corporation Limited, which has a planned programme for the establishment of factories to be known as "Remploy Factories." Reciprocal arrangements have been made with Northern Ireland under which registration as a disabled person in one country can count in the other.

From April 1, 1946, the Ministry of Labour and National Service assumed responsibility for the training of adult blind persons. It will be responsible for financial assistance to workshops for the blind which conform to an approved standard of efficiency.

The *National Advisory Council* on the Employment of the Disabled was formed in December, 1944, to consider matters referred to them by the Minister and to advise him generally on disablement problems. About 280 *Disablement Advisory Committees* have been established throughout the country to advise on local problems and make recommendations on individual cases referred to them. To enable the Ministry of Labour and National Service to deal with the placing of disabled persons in employment and with follow-up work, *Disablement Resettlement Officers* charged with the special duty of helping disabled men and women to obtain suitable employment have been appointed at every Local Office.

"REMPLOY" FACTORIES

On Wednesday afternoon, November 27, 1946, Mr. George Isaacs (Minister of Labour and National Service) inaugurated at Bridgend, Glamorgan, the first "Remploy" factory established by the Disabled Persons Employment Corporation, Ltd., for the employment of the severely disabled who are registered under the Disabled Persons (Employment) Act, 1944. The Act enables the Minister to provide facilities under "special conditions" for the employment and training of registered disabled persons unable at any time, or for any prolonged period, to work otherwise than under "special conditions." Under this authority the Disabled Persons Employment Corporation was set up by the Minister as a non-profit-making company. It was empowered to purchase or lease property and to construct or adapt premises; to staff and equip such buildings as hostels, factories and training centres; and to carry on business. Model plans have been prepared for establishments to accommodate from 100 to 300 workers each. Three factories—known as "Remploy" factories—are now in operation (at Bridgend, Salford and Longton, Staffs); a fourth was opened at Birmingham during the first week of December. Eight factories should be operating by next April, and forty more in the following year.

The Longton factory was taken over by the corporation as a "going concern," in which ex-service men have been employed since the 1914-18 war on cardboard box-making; but the majority of the projected factories will be built, or premises acquired.

Each "Remploy" factory will work as a separate unit, subject to general control by the corporation headquarters, which will have charge of the supply of materials, training schemes and the organisation of the productive work. The corporation will exercise its control through regional executive officers

in Scotland, Wales and the principal regions of England. Each factory will have its own management and staff, including a manager, an accounting officer, a welfare officer, a canteen superintendent and a first-aid officer, as well as an instructor for each class of work in which training is given.

The work, which may be carried out where appropriate on sub-contracts, will include assembly work, repair of watches, clocks, carpets, tapestries, furniture, etc., leatherwork, weaving, silverwork, etc. The aim will be to promote good craftsmanship and to give the disabled the best type of work they are capable of doing.

The majority of the employees will live in their own homes, and not many of them will require any special facilities; but where these are required billeting arrangements will be made, or, if necessary, hostels will be provided.

It may be necessary to establish sanatoria for tuberculous employees. Plans for one special factory for tuberculous workers are well advanced. Negotiations for a site are proceeding, and it is hoped that this factory, which will be for post-sanatorium cases, will be functioning in from 12 to 18 months' time. Special factories for the tuberculous will be established where there is need. The aim is to establish a factory in each region in the 1947-48 programme. Others will be added if necessary.

Special consideration is also being given to the employment of epileptics. It is difficult to gauge the size of this problem, as epileptics are reluctant to register. But part of the factories will be set aside for their employment under specially trained instructors, and when the factory at present projected for Wandsworth is completed, it is hoped to provide an entire bay for epileptics—a separate workshop inside the factory, with its own rest-room and other accommodation.

There will also be schemes for those whose disablement makes work in their own homes more suitable than factory work. The first of these has been started at Bridgend. The factory will supply materials, tools and instruction; the product will be collected by the factory and the worker paid for the work done. Tasks given to home-workers will vary according to aptitude and capabilities. Soft-toy-making, weaving, silverwork, assembly work, leatherwork and the making of table-mats and lampshades are suitable. It is hoped that in time something like a chain of " cottage industries " will be built up around each " Remploy " factory.

BRITISH COMMONWEALTH AND EMPIRE HEALTH AND TUBERCULOSIS CONFERENCE, 1947

A CONFERENCE on tuberculosis, arranged by the National Association for the Prevention of Tuberculosis of Great Britain, will be held in London from July 8 to 10 inclusive. There will be special reference to the problem as affecting the British Commonwealth, and representatives from all the Dominions and Colonies have been invited, but the conference will deal with tuberculosis in all its aspects, and it is hoped to welcome many visitors from other countries.

The Rt. Hon. Aneurin Bevan, M.P., Minister of Health, has promised to attend on the first day of the meeting, and to speak on the subject of tuberculosis and the National Health Service Act.

The sessions will include discussions on tuberculosis in the British Common-

wealth and the Colonial Tuberculosis Services; sanatorium design; after-care and rehabilitation; the psychology of tuberculosis; new discoveries in the prevention and treatment of the disease, and the National Health Service and its effect on tuberculosis schemes.

Plans are being made for overseas guests to see something of the anti-tuberculosis work for which Great Britain is famous, and will include visits to sanatoria, hospitals and clinics, and demonstrations of various kinds. The conference is open to both doctors and laymen, from this country and from overseas, and fuller particulars can be obtained from the Secretary-General, National Association for the Prevention of Tuberculosis, Tavistock House North, Tavistock Square, London, W.C.1.

REVIEWS OF BOOKS

Tuberculosis in Newfoundland (1945). By T. O. GARLAND and P. D'ARCY HART. Trade Printers and Publishers, Limited. No price given.

A nutritional survey of Newfoundland was made in 1944 by a group of experts from Canada, United States, Great Britain and Newfoundland. At the suggestion of a member of this group, an investigation of the tuberculosis problem in the island was carried out in July and August 1945 by the authors of this report.

To assess with reasonable accuracy the amount of tuberculosis in Newfoundland was a matter of considerable difficulty. The mortality figures are reliable only in certain localities, including the capital city. Moreover, notification of newly discovered cases is not obligatory, nor is there any register of the number of patients undergoing treatment. The figures available showed that the mortality from tuberculosis in Newfoundland is two to three times that in England and Wales. The number of cases of active pulmonary tuberculosis was estimated as being between 3 and 4 per cent. of the population, which is three or four times the incidence in England.

The causes of this high incidence of the disease are examined in detail. It is interesting to note in this connection that the death-rate from tuberculosis among women in the island is higher that that amongst men. This is in contradistinction to the state of affairs in Great Britain, and it is suggested that fatigue may have a bearing on this. The women have an endless struggle against difficult circumstances, while many of the men work only during a short fishing season.

The authors, having made clear the serious nature of the problem, proceed to make a series of lucid detailed recommendations as to the measures for dealing with it. These recommendations include the provision of more sanatorium beds, and beds for the institutional care of those patients too advanced for admission to sanatoria. They also recommend the appointment of a Director of Tuberculosis Services, and make suggestions as to the arrangement of a Tuberculosis Scheme for the island.

This is a very interesting report, particularly in the survey it provides of the conditions of life in Newfoundland. These are in many ways primitive, and social legislation is backward. The relationship of these factors to the incidence of tuberculosis is clearly demonstrated. H. N.

La Pratique du Pneumothorax Thérapeutique Artificiel. By DUMAREST, F., *et al.* Masson et Cie., Paris. Pp. 416. Paper backed. Price 375 fr.

This is the fifth edition of what is probably one of the best books in any language on the subject of Artificial Pneumothorax. It is a most valuable work, not only from a practical point of view in describing in detail the indications and the conduct of the treatment with its complications, but also in its discussion of the theoretical basis of collapse theory, which makes the book stimulating and enjoyable. There are full chapters on bilateral pneumothorax, on pleuroscopy and section of adhesions, and on the other methods of collapse—thoracoplasty, phrenicectomy, pneumoperitoneum, aspiration of cavities (Monaldi), etc.

A very balanced account is given of the decision whether in an early case of tuberculosis one should perform an artificial pneumothorax at once, or whether one should wait a little, and be guided by the changing radiological appearances (including the use of tomographs). The problem, of course, is to recognise at the earliest possible moment the direction in which the disease is evolving. The author admits that only very rarely has he had cause to regret having begun an artificial pneumothorax; more often has he regretted not having done so. There are numerous references to other workers, mostly French, but some American. As might be expected, English readers will disagree with some of his opinions. For example, he considers that the dyspnœa seen at the beginning of artificial pneumothorax is cardiac in origin (p. 120). He uses subcutaneous injections of oxygen for dyspnœa, which, from studies of blood gases, are regarded here as valueless. He still recommends gold injections when the disease spreads to the sound lung (p. 124). Penicillin in the suppurative pleurisies is not mentioned, no doubt because it has not been generally available in France until recently.

A more important blemish is the poverty of illustrations and the absence of radiographs, the place of which is taken by line drawings.

In spite of these criticisms, the writer considers this book is worthy of the closest study by all workers in this field, representing as it does so many years of careful observation and experience.

R. H.

Pulmonary Tuberculosis: A Handbook for Students and Practitioners. By R. Y. KEERS and B. G. RIGDEN. Foreword by F. H. Young. E. and S. Livingstone, Ltd. Edinburgh. Price 17s. 6d. net.

The second edition of this excellent book has been produced in little more than eighteen months after its original publication. It presents an admirable guide to pulmonary tuberculosis. It is brief and clearly written, and the reproductions of X-rays are good and well arranged. A further merit is that in the clinical chapters the authors describe methods and observations that they have found useful in their own practice. Thus it is a relief to find a textbook which does not even mention Traube's space or Grocco's triangle.

In this edition the section on Pneumoperitoneum has been expanded, and more attention given to B.C.G. vaccination. The provisions of the Disabled Persons (Employment) Act, 1944, have been explained, and parts of the chapters on Pathogenesis have been rewritten.

For the student and general practitioner this is a most useful book, and many of those actually engaged in the care of patients with pulmonary tuberculosis would find its perusal not without profit.

H. N.

Unequal Ventilation of Different Parts of the Lung, and the Determination of Cardiac Output. By P. E. RAUWERDA. 152 pages and 55 separate figures. *From:* Rijks-Universiteit. Groningen. 1946. Price 35s.

The author of this monograph was led to a study of the ventilation of the lung by realising certain data were missing for an accurate assessment of the reliability of the gas-analytical determination of the cardiac output by Grollmann's method. In this method it is necessary to know what factors influence the mixing of the foreign gas in the lung-bag system; to know under what conditions one may get a reliable gas sample that is in equilibrium with the alveolar air. After a full examination of the literature on the subject, he finds that there have been expressed different, and even opposing, viewpoints on the problem of lung ventilation and the mixing in a lung-bag system, and that more evidence is required before a valid opinion can be held. The greater part of the book is taken up with demonstrating, mainly by deduction from gas-analyses involving complicated and ingenious apparatus and calculations, that there is an unequal ventilation of different parts of the lung. He then discusses, with this new information as a basis, the necessary modifications in the existing Grollmann technique. Since these include taking air samples during a series of rapid respirations, he finds it necessary to conduct further experiments to determine the circulation time in hyperventilation. Rauwerda comes to the conclusion that the Grollmann method is, on the whole, a reliable one.

The book will repay careful study by those actually using Grollmann's method, and will probably lead to a modification in their technique, and certainly to a greater insight into the problems associated with the method. For the general physiologist and the clinician the unquestioned importance of the conclusions reached concerning lung ventilation do not, however, warrant their reading so extensive a monograph; a short article summarising the work is obviously called for.

There is an omission, in the otherwise valuable set of 338 references, of some of the recent work on cardiac output in America and Britain; but perhaps this is due to war-time difficulties in Holland. There is unfortunately no index. The translation is adequate.

K. R.